Technology Infusion Working Group

Mission
Enable NASA Earth Science Enterprise to reach its research, application, and education goals more quickly and cost effectively through widespread adoption of key emerging information technologies
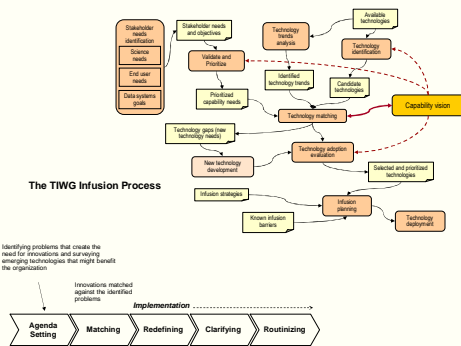
Scope
Information technologies that...
- Provide capabilities critical to ESE mission & vision
- Have been substantially developed (TRL 6-9) but not widely deployed
- Cannot be obtained simply through reuse of mature subsystems or software
- May be slow to adopt due to unique characteristics of Earth science data (e.g., large volumes, 4-dimensions)
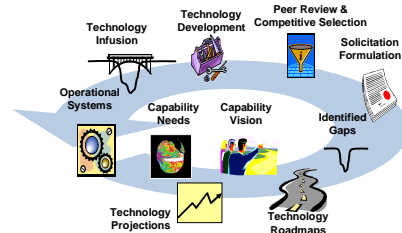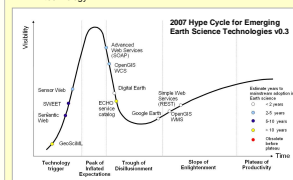

Process and Strategies Subgroup

- **Understand the technology infusion process**
- **Complete and publish infusion readiness assessment**
- **Define a process for monitoring new and emerging technologies**
  - How do we identify the disruptive innovations?
  - How do we assess technology maturity?
- **Develop TIWG Earth science technology radar – a graphical representation of new and emerging technologies, their relevance and importance to the Earth science community.**
- **Look at what is happening in the wider Earth science community – e.g. Geospatial One Stop, FGDC, Geospatial Line of Business.**
- **Subgroup leads: Steve Olding, GSFC and Joe Glassy, UMT**

The TIWG Infusion Process

Identifying problems that create the need for innovations and surveying emerging technologies that might benefit the organization

The Innovation Process in an Organization

Source: Rogers (1995),"Diffusion of Innovations"

Identifying New and EmergingTechnologies

Technology Hype Cycle (Gartner)
- "Technology Trigger"
  - The first phase of a Hype Cycle is the "technology trigger" or breakthrough, product launch or other event that generates significant press and interest.
- "Peak of Inflated Expectations"
  - In the next phase, a frenzy of publicity typically generates over-enthusiasm and unrealistic expectations. There may be some successful applications of a technology, but there are typically more failures.
- "Trough of Disillusionment"
  - Technologies enter the "trough of disillusionment" because they fail to meet expectations and quickly become unfashionable. Consequently, the press usually abandons the topic and the technology.
- "Slope of Enlightenment"
  - Although the press may have stopped covering the technology, some businesses continue through the "slope of enlightenment" and experiment to understand the benefits and practical application of the technology.
- "Plateau of Productivity"
  - A technology reaches the "plateau of productivity" as the benefits of it become widely demonstrated and accepted. The technology becomes increasingly stable and evolves in second and third generations. The final height of the plateau varies according to whether the technology is broadly applicable or benefits only a niche market.

2007 Hype Cycle for Emerging Earth Science Technologies v0.3

Prediction Markets (e.g. Yahoo Tech Buzz Game)

What is the Tech Buzz Game?
The Tech Buzz Game is a fantasy prediction market for technology. Your goal as a player is to predict how popular various technologies will be in the future. Popularity or buzz is measured by Yahoo! Search frequency over time. Predictions are made by buying virtual stock in technologies you think are about to boom, and selling when substance doesn't match the hype.

Expert Knowledge + Tracking Tech Trends (e.g. O'Reilly Radar)

"Our methodology is simple: we draw from the wisdom of the alpha geeks in our midst, paying attention to what's interesting to them, amplifying these weak signals, and seeing where they fit into the innovation ecology. Add to that the original research conducted by our Research team, and you start to get a good picture of what the technology world is thinking about. What books are people just now starting to buy, and which are falling off in interest? Which tech-related Google AdWords are rising or falling in price? What can we learn from predictive markets tracking tech trends? What do the high-wanted ads tell us about technology adoption?"
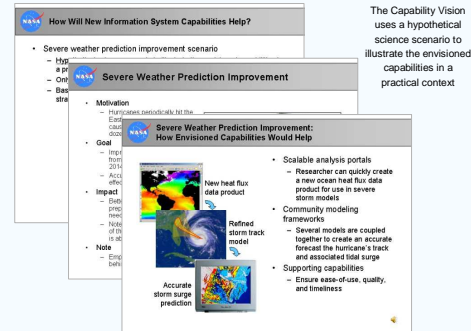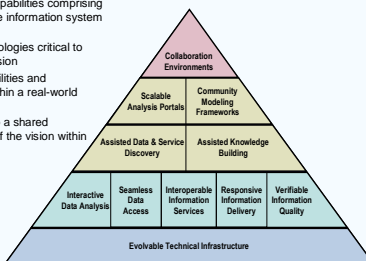
Folksonomy/Social Tagging

A folksonomy is a system of classification derived from the practice and method of collaboratively creating and managing tags to annotate and categorize content; this practice is also known as collaborative tagging, social classification, social indexing, and social tagging. TIWG uses the tag "twg-radar".
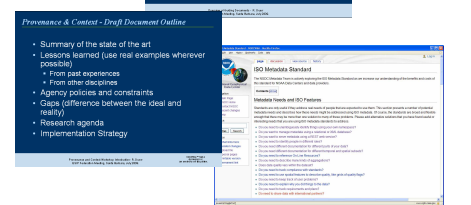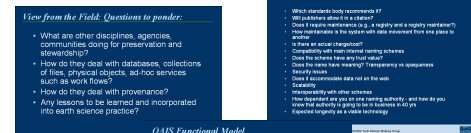
Earth Science Capability Vision

Capability Vision
- Describes 11 capabilities comprising an Earth science information system capability vision
- Identifies technologies critical to achieving the vision
- Positions capabilities and technologies within a real-world scenario
- Used to develop a shared understanding of the vision within the community

The Capability Vision uses a hypothetical science scenario to illustrate the envisioned capabilities in a practical context

Data Stewardship Subgroup

- **Understand data stewardship issues**
- **Push the research agenda**
- **Influence data management decisions**
- **Support the Federation Preservation and Stewardship Cluster**
- **Subgroup lead: Ruth Duerr, NSIDC**

Characteristics of the Ideal Identifier

View from the Field: Questions to ponder:

OAIS Functional Model

Provenance & Context - Draft Document Outline
- Summary of the state of the art
- Lessons learned (use real examples wherever possible)
  - From past experiences
  - From other disciplines
- Agency policies and constraints
- Gaps (difference between the ideal and reality)
- Research agenda
- Implementation Strategy

Sensor Web Subgroup

- **Define the key features of sensor webs.**
- **Identify benefits and challenges.**
- **Explore a vision for sensor webs.**
- **Subgroup lead: Karen Moe, GSFC/ESTO and Michael Goodman, MSFC**

A Sensor Web Vision

- A Vision for NASA Sensor Webs for Earth Science - On-demand sensing of a broad array of environmental and ecological phenomena across a wide range of spatial and temporal scales, from a heterogeneous suite of sensors both in-situ and in orbit.
- Sensor webs will be dynamically organized to collect data, extract information from it, accept input from other sensor / forecast / tasking systems, interact with the environment based on what they detect or are tasked to perform, and communicate observations and results in real time.
- *Definition: A coordinated observation infrastructure composed of a distributed collection of resources that can collectively behave as a single, autonomous, task-able, dynamically adaptive and reconfigurable observing system that provides raw and processed data, along with associated meta-data, via a set of standards-based service-oriented interfaces.* (AIST)
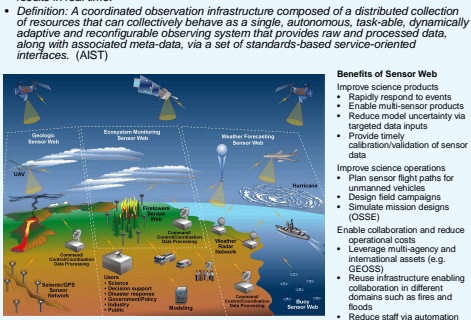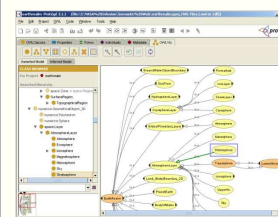

Benefits of Sensor Web

Improve science products
- Rapidly respond to events
- Enable multi-sensor products
- Reduce model uncertainty via targeted data inputs
- Provide timely calibration/validation of sensor data

Improve science operations
- Plan sensor flight paths for campaigns
- Design field campaigns
- Simulate mission designs (OSSE)

Enable collaboration and reduce operational costs
- Leverage multi-agency and international assets (e.g. GEOSS)
- Reuse infrastructure enabling collaboration in different domains such as fires and floods
- Reduce staff via automation

Semantic Web Subgroup

- **Develop awareness and understanding of Semantic Web technologies and capabilities within the working group.**
- **Develop a plan for wider dissemination of technologies, capabilities, and opportunities to the wider Earth science community.**
- **Contribute to the maturation of Earth science ontologies.**
- **Identify components of semantic web and map to NASA TRLs.**
- **Develop a roadmap for Semantic Web infusion in the Earth science domain.**
- **Support the Federation Semantic Web Cluster in developing demonstrations.**
- **Subgroup lead: Peter Fox, RPI and Rahul Ramachandran, UAH**

- Ontology (n.d.). The Free On-line Dictionary of Computing. http://dictionary.reference.com/browse/ontology
  – An explicit formal specification of how to represent the objects, concepts and other entities that are assumed to exist in some area of interest and the relationships that hold among them.
- Semantic Web
  – An extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation. www.semanticweb.org
- Semantic Grid
  – Semantic services to use the resources of many computers connected by a network to solve large scale computational problems
- Provenance
  – origin or source from which something comes, intention for use, who/what generated for, manner of manufacture, history of subsequent owners, sense of place and time of manufacture, production or discovery, documented in detail sufficient to allow reproducibility.
- Technology Infusion Roadmap
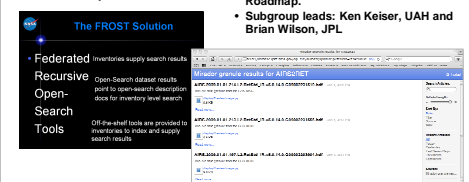 – Timeline for widespread adoption of key technologies including tailoring to Earth science needs

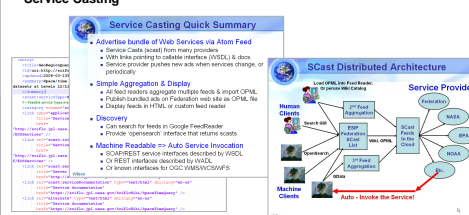### Semantic Web Roadmap and Gap Analysis

Services Interoperability and Orchestration Subgroup

- **Promote the adoption of interoperable information services within the Earth science community.**
- **Develop practical demonstration(s) of web services technologies and services orchestration capabilities. Document lessons learned from the demonstrations.**
- **Review and update the Web Services Roadmap.**
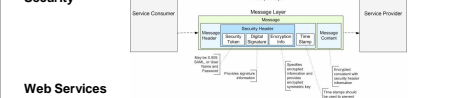- **Subgroup leads: Ken Keiser, UAH and Brian Wilson, JPL**

Federated OpenSearch

The FROST Solution
- Federated — Inventories supply search results
- Recursive Open-Search — Open-Search dataset results point to open-search description docs for inventory level search
- Tools — Off-the-shelf tools are provided to inventories to index and supply search results

Service Casting

Service Casting Quick Summary

SCast Distributed Architecture

Web Services Security

Web Services Roadmap

Last Updated: 10/09/09 by Steve Olding